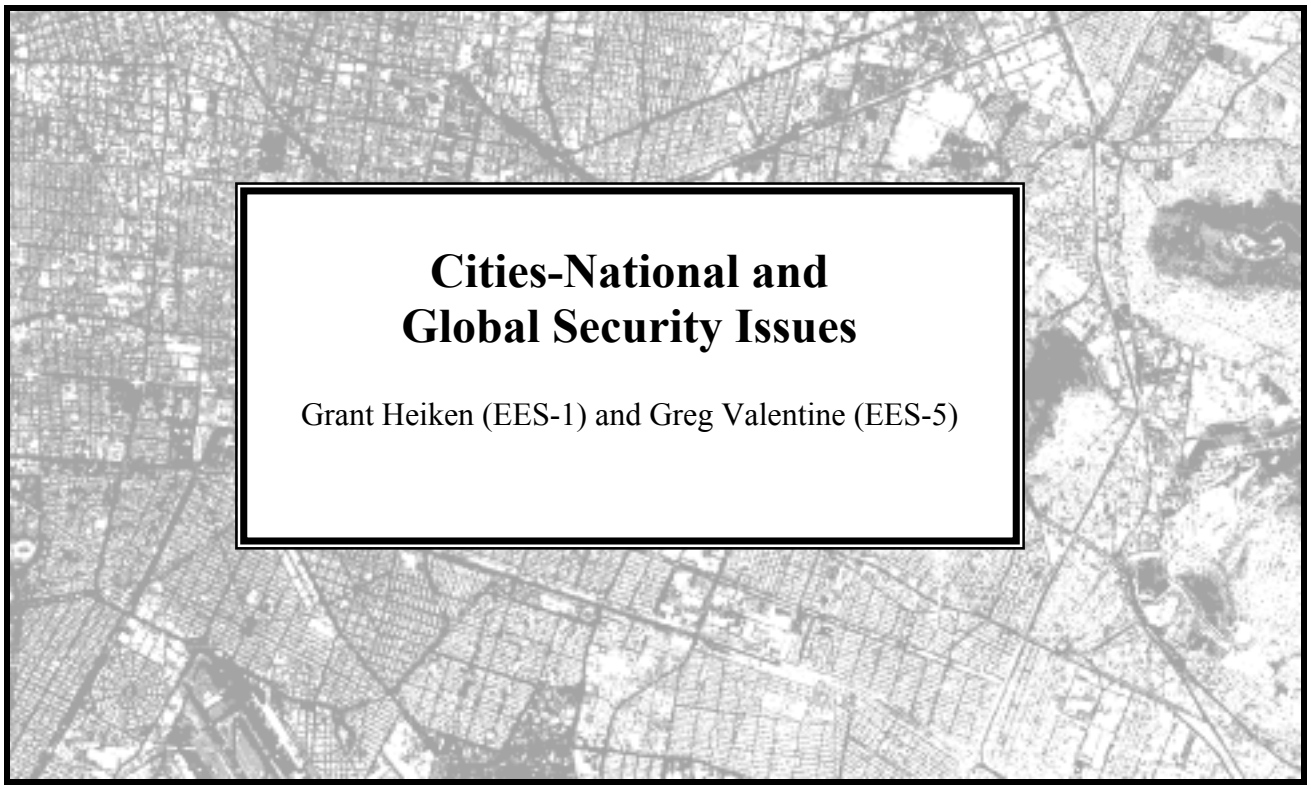

Cities-National and Global Security Issues

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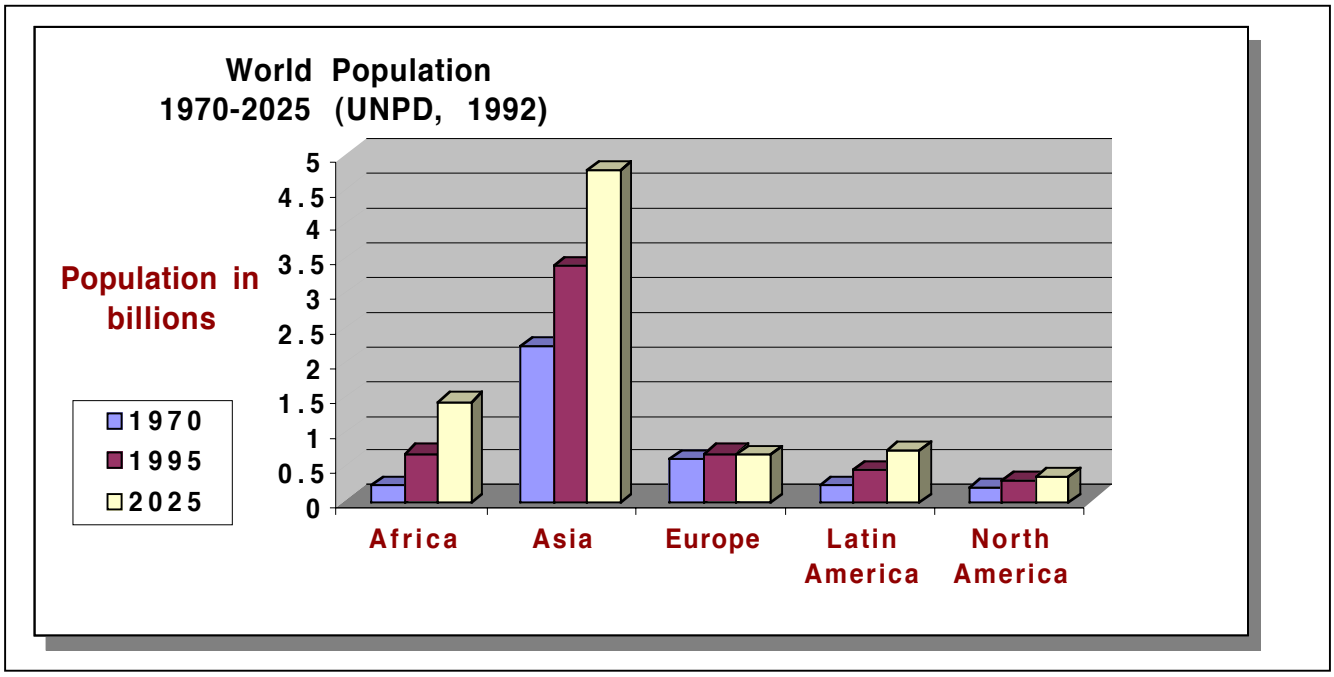
The majority of the world's human population will soon reside in cities, rather than in agricultural settings as has been the case throughout history. This unprecedented change has both positive and negative aspects, many of which have not been anticipated by traditional thinking. The United States and other nations need to actively move toward viewing cities as national resources, where security depends upon urban stability, and where the societal, economic, infrastructure, and environmental components of cities are treated in an integrated manner, based on scientific observation and analysis.

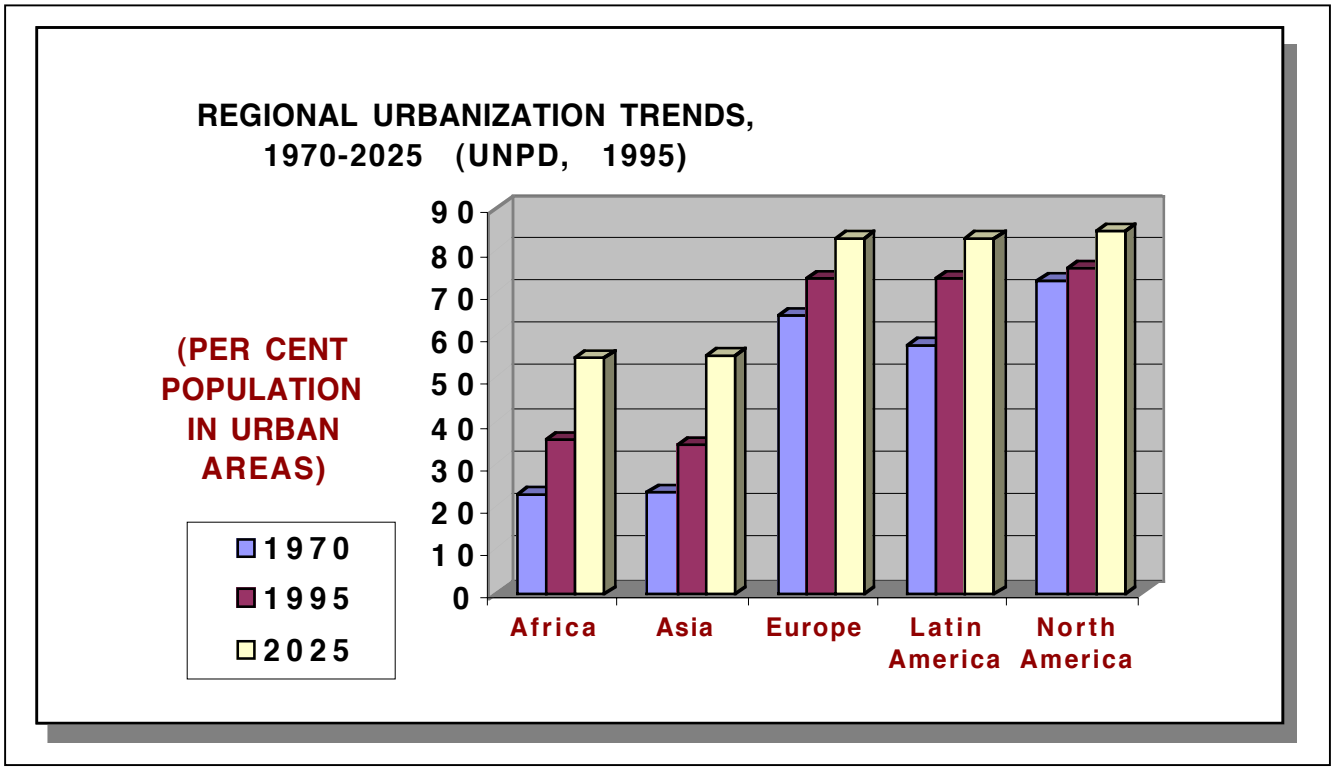
To understand and better manage cities we are calling for changes in the underlying thinking of governments and the scientific community. We believe that there must be a concerted effort to integrate research on urban problems across the various Federal and state agencies that are involved with urban issues. Similarly, the international community needs to invest in new approaches to resolve urban issues around the world. All of this is in recognition that events in major cities have consequences that can reach far beyond municipal, state, or national boundaries. The scientific community needs to further embrace urban systems as an important and credible field of research. University departments need to collaborate for the purpose of promoting interdisciplinary curricula to train a new generation of science-based urban planners. Physical and biological scientists need to increase their collaborations with the social sciences, economists, and infrastructure engineers. Government laboratories need to use their horsepower and experience in applying science and technology to large societal problems for improving the urban condition. None of these changes will be easy, given the inertia that has built up over the last century. However, we argue that new thinking is mandatory as we move into the urban era of the 21st century.

The problem

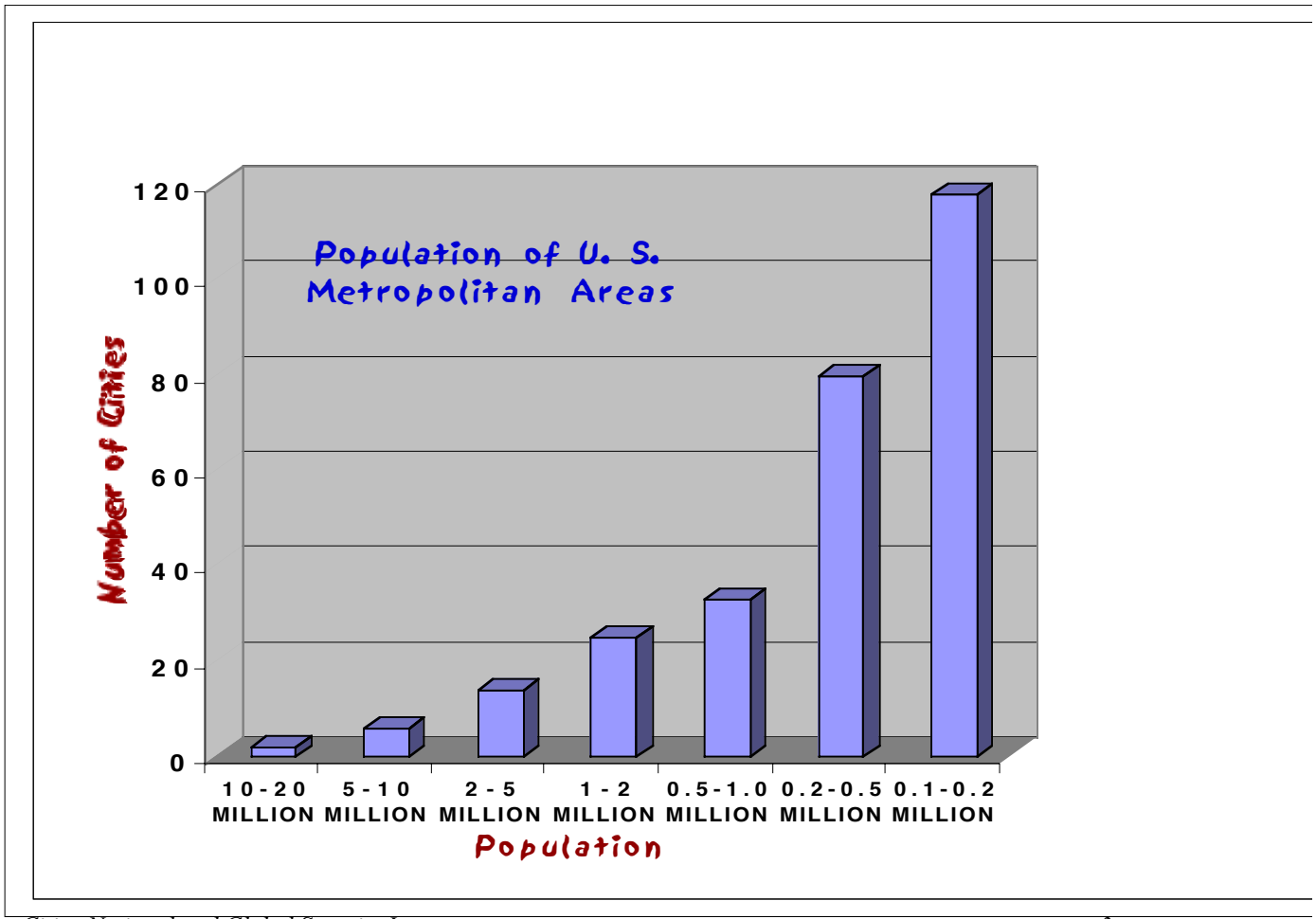
In 1950 30% of the world's population lived in cities and towns, increasing to 45% by 1995. According to the United Nations Population Division, the world population will undergo a major transition by about 2005 when the majority of humans will be in cities. There are multiple reasons for this transition. In many developing nations the change is driven by a perception of increased economic opportunities in metropolitan areas. In developed nations, urban population growth is accelerating as rural migrants move into the cities for access to employment, goods and services. In the world today there are 28 cities with populations over eight million, the so-called "megacities." 73% of the population of the U. S. lives in towns and cities, which include 47 U.S. metropolitan areas of over a million people and 198 U. S. cities with populations of 100,000-500,000.



Past, present, and projected global populations, by region.



Percentage of population living in urban areas, by region



As cities increase in size and complexity, so do the issues of economic and political stability that are responsible for the quality of life. Increasingly, cities face problems that may have technical solutions—if the technical solutions are integrated with the more traditional approaches to municipal infrastructure maintenance, emergency response, public health, and planning.

With increasing urbanization the role of cities will be even more important to national and global security issues. Major incidents of social violence are mostly in cities and include civil war, urban terrorism, riots or street protests, and "external" warfare. The recent example of the destruction of Grozny, Chechnya is illustrative of the strategic value of cities and the consequent tragedy and reconstruction for the civilian population. Cities are focal points for terrorist activities. Within the U. S. during the last decade, tragedies in Oklahoma City and New York emphasized the future problems of terrorism affecting the increasing numbers of our citizens living in cities.

CITIES WITH MAJOR INCIDENTS OF SOCIAL VIOLENCE SINCE 1989 (MITCHELL, 1999)

Civil/Internal War or Urban Terrorism		Riots or Street Protests by the Civilian Population	External Warfare
Baku	Madrid	Beograd	Baghdad
Beijing	Manchester	Bombay	Beograd
Bogota	Mogadishu	Calcutta	Groznyi
Buenos Aires	Monrovia	Dhaka	
Cairo	Moscow	Jakarta	
Colombo	New York	Los Angeles	
Kabul	Oklahoma City	Rangoon (Yangon)	
Karachi	Paris		
Kinshasha	Phnom Penh		
Lahore	Port au Prince		
Lima	Tblisi		
London	Tokyo		

The effects of natural hazards are most costly in the cities. In addition to the personal tragedies associated with loss of life and injury during floods, typhoons, and earthquakes (for example) there are tremendous financial effects. The Munich Reinsurance Company estimates that $100 billion will be lost in 2000 because of natural disasters. These estimates increase in 2010 to $270 billion and in 2020 to $700 billion. The increases are because of increased urbanization and wealth.

The foci for epidemics are the cities. Closely-packed humans, public transportation, and polluted water provide an ideal environment for the spread of disease.

Large cities are places where infrastructure elements such as telecommunications, transportation, and electricity, as well as economic activity converge. This convergence makes cities more vulnerable to natural and human-made disasters as well as poor long-term planning decisions. Disruption of a city's infrastructure can have far-reaching effects. Some authors write of the "footprint" of a city as the region from which a city pulls its resources, that receives the city's waste, or that depends to first order on the city's economy. City footprints usually extend far beyond the city limits. For example, Los Angeles draws electricity that is generated in Washington, relies on lumber from the Pacific Northwest, and plays a role in the global economy. Most western states and, to some extent, the nation would be damaged by physical and economic collapse in Los Angeles.

Cities as "hubs" for critical infrastructure are evident in this night sky image of North America

The natural setting of a city is the underpinning of its infrastructure and health. In the past, those who managed cities frequently considered the environment to be an infinite resource for materials and an infinite sink for waste and byproducts. Planning decisions were made with little or no regard for the role that the environment plays in the long-term stability of a city. However, the continued

growth of urban centers places increasing stress on the environment, and the environment in turn stresses the city. To demonstrate such connections, simulation studies at Los Alamos and the University of California-Santa Barbara predicted that a moderate earthquake on the Elysian Park fault beneath Los Angeles would produce major blackouts in the Los Angeles metropolitan area, affecting emergency response and the recovery of all utilities in the region, and producing brownouts throughout the western states and British Columbia. This scenario is an example of the coupling between environmental disasters and infrastructure. This example illustrates how the short-term interplay between natural disasters and infrastructure becomes a key aspect of the urban problem. This long-term interplay is critical in planning for urban sustainability.

The best infrastructure engineering and environmental planning can be completely ineffective if they do not satisfy the needs of, or are not supported by, the people and a city's economy. Therefore all urban problems should be thought of within the context of the links between society, economy, infrastructure, and environment.

Integrated Urban Science Research Problems

At this time (2000 AD) we propose that the major research problems lie in understanding the interdependencies of the natural and human systems that comprise a city. Understanding an urban system requires an approach that integrates physical processes, economic and social factors, and nonlinear feedback across a broad range of scales and disparate process phenomena. By developing the tools required to reach this understanding for each city, we will be well on the way to aid municipal authorities in handling the problems of:

1. Mitigating natural disasters via hazard mapping, natural process modeling, and crisis forecasting.
2. Long-range planning. With an integrated model, a city government can best decide how to use funds to, for example, maximize the effectiveness of a new water or transportation system.
3. City management. How best to handle integrated infrastructure-transportation-public health-economy-quality of life. The managers of systems that are the lifeblood of the world's cities are mostly isolated from one another. For example, the mutual dependence of water, electrical, and sewage systems and the economy and environment are not evident until there is a disaster such as an earthquake or hurricane. We need to understand these connectivities by running cities without the management barriers that block an understanding of all natural and man-made systems. Cities need integrated teams to collect data and make observations, from a holistic viewpoint, that can be wrapped into quantitative models of the city that can be used to alleviate vulnerabilities to natural disasters, terrorist attacks, and bad planning decisions.
4. Emergency response—natural hazards, fire, riot, public health, and chemical spills.
5. The role of cities as infrastructure hubs.
6. Effects of the urban population on the environment and vice-versa.

Innovative approaches to urban issues

According to G. S. Cheema, of the United Nations Development Program, "The urban research agenda …should focus on the identification of innovative approaches to deal with the complex issues in urban management and on strengthening national capacities to plan and implement urban development programs."

Cities must view themselves as national resources, realizing that their unique cultural and economic roles are crucial to the strength of the Nation's fabric. Many security issues are woven into the success or failure of city planning and management. As national resources and security flashpoints, cities should help direct the Federal urban research agenda. There must be some recognition that when a major city suffers, the effects can reach far beyond the municipal boundaries and into the entire nation.

To support research on a "systems" view of cities it will be necessary to integrate across the various government agencies that are currently involved in urban issues and could bring important resources to municipalities. Currently urban responsibilities are parceled out among a number of Federal agencies: Transportation, Housing and Urban Development, Environmental Protection Agency, and the Federal Emergency Management Agency are among the organizations that have the largest and most direct ties to cities. Other agencies are involved to lesser degrees but have tremendous capabilities that could be used in the cities. These include the Department of Energy (multidisciplinary laboratories, computing and instrumentation, energy efficiency, infrastructure security), U.S. Geological Survey (geologic and hydrologic resources, natural hazards), Department of Defense (counter-terrorism, emergency response), National Science Foundation (ecological and urban systems research). As things are currently organized it is difficult to pursue an integrated approach to urban problems because no single organization is charged with the big picture. We suggest that the U.S. Government establish an interagency commission with a strong charter to use and integrate all of the above capabilities. Such an urban security commission should have an R&D and implementation budget and streamlined mechanisms to fund integrated work in the various agencies and to manage that work. The make-up of the commission's leadership should reflect its charter for research integration, and should have the following expertise: urban planning, economics, sociology, transportation, energy/telecommunications infrastructure, hydraulic engineering, environmental, earth, and atmospheric sciences, and emergency response. The commission must be viewed as a collaborator and not a regulator.

Key players missing as city employees are from the sciences, especially systems, earth, and atmospheric sciences. At this time, these professions are mostly in the universities, state and federal agencies. Where can they help? The list is long and includes, to name a few: water—sources and quality; air quality; energy resources and building materials; the fate and transport of chemical species from pollution or chemical/biological attacks; natural hazards mitigation—by hazards mapping, zoning, and hazards scenarios; public health after a natural disaster; greenbelts and urban agriculture; the effects of sea-level rise; thermal extremes and health effects; and understanding urban microenvironments as incubators of disease.

Until governing bodies of metropolitan areas establish their own applied science expertise, support for science-based, integrated urban planning will come mainly from the traditional base of the Federal government. Such programs are beginning to jell. One example is the NSF-sponsored "Long-Term Ecological Research" projects in metropolitan Phoenix and Baltimore. Also, the "Urban Security Initiative" at Los Alamos was developed to approach urban modeling from a multidisciplinary perspective. The approach used by the Los Alamos team is based upon simulation science and the high-performance computing platforms that are required to evaluate the interactions between urban subsystems. However, there will be limits to the roles that these efforts play in solving urban problems until an integrating organization, such as the commission described above, is put in place and empowered by the Federal Government.

A focus on integrated urban systems also presents a new challenge for the scientific community, especially those of us in the natural sciences, who, like many (but not all) city managers and infrastructure managers, "work in a box." Integrated science is becoming a common approach to understanding natural (and man-made) systems and can be seen in the reorganization of some traditional, discipline-oriented university departments into interdisciplinary institutes or divisions. Students trained in this way must be willing to leave the academic fold to work for the cities and the cities must be convinced that they will gain by hiring these pioneers and looking at new ways of managing a city. A holistic understanding of cities is important to national and global security.

What is the Role for Los Alamos?

"Los Alamos will be the premier laboratory in the world applying science to the solution of technical problems critical to national and global security". **(1999-2004 Institutional Plan)**

At this time, when nearly 75% of the population of the United States and about 48% of the global population resides in cities, urban security will be of paramount importance in the new millennium. The Laboratory, with its broad spectrum of disciplines and computing capability is in a perfect position to assume research leadership in integrated urban science, mainly from its ability to conduct interdisciplinary research and access to high-performance computing platforms. From 1943 to the present, most of the Lab's research has been linked to global events, ranging from World War II to stockpile stewardship. It will not be possible to avoid events generated in a rapidly urbanizing world, including the effects of natural hazards, "homeland defense," uncontrolled growth, and environmental security.

The Laboratory has many components necessary for an urban science mission, including:

- *Urban Security*; development work and projects in Dallas and Los Angeles (EES, TSA, CIC, T, ESA, & CST)
- *Delphi/Crisis Forecasting* (CIC, EES, TSA)
- *Critical Infrastructure Protection*; national, but with city hubs (TSA)
- *TRANSIMS*; development work and projects in Dallas and Portland (TSA, CIC)
- Research on epidemics (B, T)
- *Integrated Environmental Modeling*; Albuquerque and potential work in arid cities (EES, CIC)
- *Chem/Bio* threat reduction; development work, with projects in Los Angeles and Salt Lake City (TSA, EES)
- Atmospheric research; Mexico City and El Paso / Juarez (EES, TSA)
- Collaboration with Phoenix Long-Term Ecological Research Project (EES, TSA)

- Virtual training environments for emergency responders (TSA)

To build on what we have at the Laboratory, we must continue interdisciplinary, inter-divisional research and add in more of the human dimension, with research that integrates the social, behavioral, and economic sciences into our projects.

There must be "champions" in the DoE, any other appropriate agencies, and in Congress, who will support the initiatives necessary for integrated urban research.

Summary

Governments at all levels and the scientific community must recognize that most of humanity will soon be living in cities. The complexity of cities demands that integrated approaches be taken to achieve an understanding of the urban "system of systems" required to identify weaknesses and to enhance sustainability. The Laboratory has the staff and computing platforms to conduct research on complex urban systems. The development and utilization of integrated studies should revolutionize the way we address urban issues. The *status quo* of traditional planning and management by a myriad of bureaucracies cannot handle the complexities of large cities. Now is the time to prepare for humanity's transition from a rural to an urban human environment that is only five years away.